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Pediatric Traumatic Brain Injuries: Challenges in Providing Effective Patient Care and Importance of Proper Family Support

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Pediatric Traumatic Brain Injuries: Challenges in Providing Effective Patient Care and Importance of Proper Family Support

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Abstract

The human brain is one of the most important, yet least understood, organs in the human body. This functional unit innervates every aspect of human life and is ever changing from conception until full maturity around age 25. Considering this, it makes sense that pediatric traumatic brain injuries are so misunderstood. Attempting to diagnose and monitor a traumatic injury to a complex organ that is still growing and developing is challenging for clinicians. Proper interaction with these children and their families is vital to physical health and psychosocial development. Identifying current knowledge and disseminating it is crucial for planning interventions and promoting healthy outcomes. A review of the literature was done using the CINAHL database, and articles collected identify themes that are important and unique to caring for these patients. The themes are (a) impact of age at time of injury on post injury behavior; (b) importance of proper identification of TBI related behaviors and appropriate interventions; (c) relationship between severity of injury and post injury behaviors; (d) patient challenges with internalizing and externalizing problems; and (e) role of home environment on post injury behaviors and recovery process. When caring for this patient population, it is important for health care providers to not use a "one size fits all" approach, as each patient will have a different presentation and different needs based on the factors listed above. The themes identified here provide a point of reference for clinicians when planning care for children who have experienced a traumatic brain injury.

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Pediatric Traumatic Brain Injuries: Challenges in Providing Effective Patient Care and Importance of Proper Family Support

Of the 37,000 children under the age of 14 that are admitted to the hospital each year for traumatic brain injuries in the United States, 30,000 of these patients will suffer permanent disability, and 3,000 of them will die (Juang, Gonzalez, & Ostlie, 2020). Based on these statistics alone, it is clear that pediatric traumatic brain injuries are not a small-scale issue. Traumatic brain injuries (TBI's) in and of themselves are complex medical cases that are difficult to understand due to the abstract nature of the brain. In adults with traumatic brain injuries, there has been extensive research done that allows for a working understanding of the adult brain, and a knowledge of exactly what the consequences of injury will be depending on the area affected. While TBI's are simpler to understand and more predictable in a fully developed brain, we must keep in mind that the human brain does not reach full maturity until approximately the age of twenty-five (Campellone & Turley, 2021). Based on information from the American Pediatric Surgical Association, it is understood that pediatric patients are more susceptible to brain injuries than adults (Juang, Gonzalez, & Ostlie, 2020). Having this knowledge about how pediatric traumatic injuries have life-altering impacts on thousands of children every year, it is our duty as healthcare providers to identify the weaknesses in care when providing for this patient population, combine it with the current knowledge surrounding the pathophysiology of this injury, and use that to elevate the level of care to provide these children with a higher quality of life post-injury.

Background

The developing brain has a higher water concentration than an adult brain, which is associated with only having partial neuronal synapse formation and arborization. This means that the synapses that have been successfully formed are weaker and fewer in number than what would be found in an adult brain, therefore making any injury to the pediatric brain more detrimental. Pediatric brains are also less buoyant and have less protection than the mature adult brain due to a smaller subarachnoid space. The subarachnoid space in a fully developed adult acts as a buffer that allows some movement of the brain within the skull without causing injury. In pediatric patients, this "buffer" space is much smaller which makes them much more susceptible to TBI's, even when the mechanism of injury is one that seems insignificant and may not have any effect on an adult brain (Juang, Gonzalez, & Ostlie, 2020). Considering this increased level of vulnerability, clinicians treating pediatric patients (compared to adult patients) who have suffered traumatic brain injuries may face unique challenges.

While there are multiple different types of TBI's that are differentiated by severity and the pathophysiological changes occurring in the brain, a traumatic brain injury can be defined as "a disruption in the normal function of the brain that can be caused by a bump, blow, or jolt to the head, or penetrating head injury" (US Department of Health and Human Services, 2020). This category of injury is a leading cause of morbidity and mortality in pediatric patients, and is most often caused by falls, unintentional blunt trauma, motor vehicle accidents, or assault/child abuse (Juang, Gonzalez, & Ostlie, 2020). The vulnerable brains of these young patients are still in their prime years of

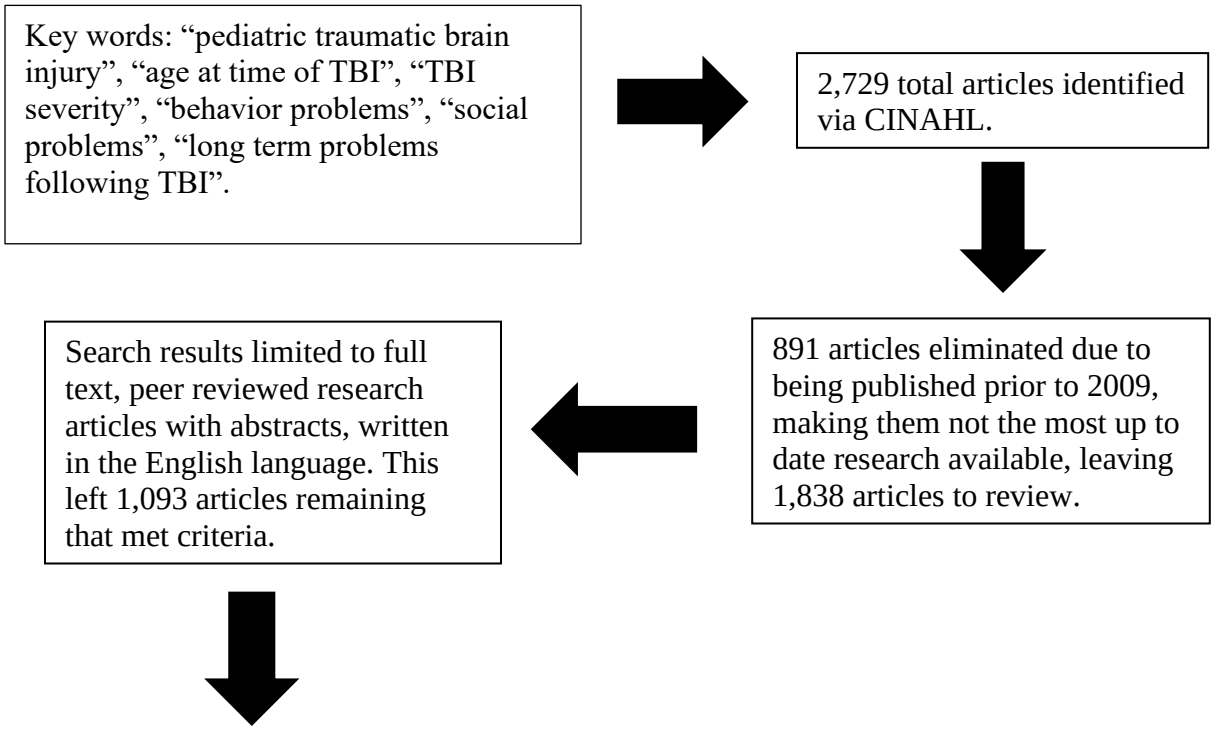
growth/development, and are responsible for learning skills and creating memories that will be with these children for the rest of their lives. Due to the fragility of these brains and the critical impact that this injury has on a child's life, it is imperative that proper interventions are put in place, healthy outcomes are being promoted, and appropriate teaching is being provided to the child's parents (and other primary caretakers).

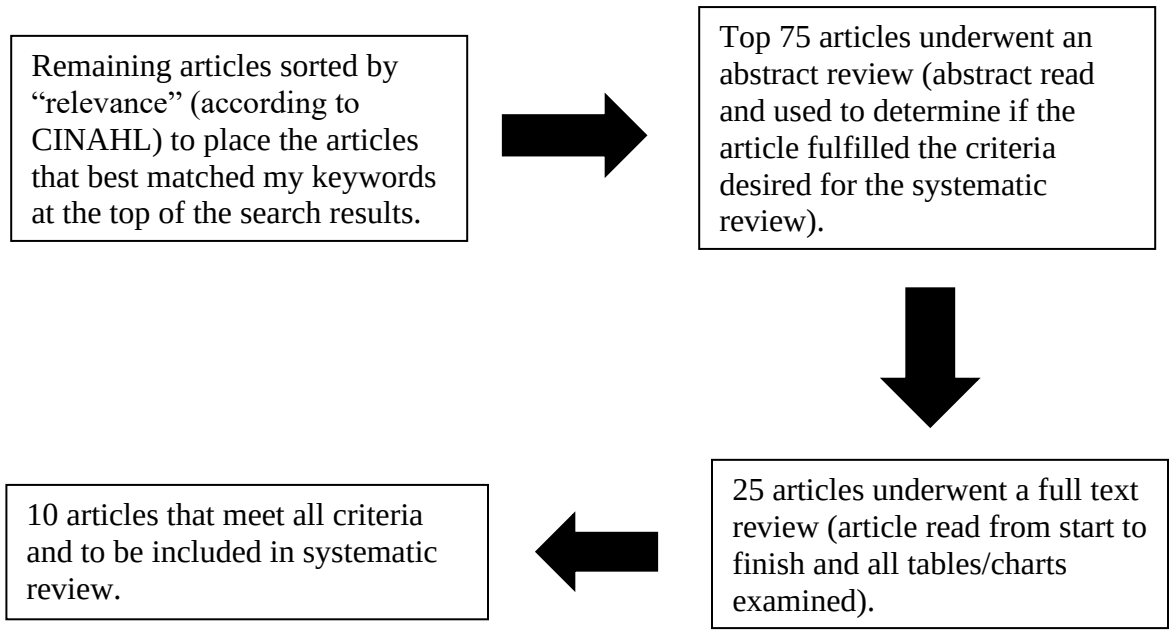
This systematic review of the literature will provide a well-organized presentation of current knowledge on pediatric traumatic brain injuries and communicate the specific needs of, and challenges associated with, this unique patient population. Ultimately, we ask what are the most important factors to consider in children who have suffered a traumatic brain injury, and how does recognizing these factors help healthcare providers to plan individualized care, in turn promoting the patients and their families to achieve healthy outcomes?

Methods

A systematic review of the literature was conducted, and research articles were identified via the CINHAL Plus with Full Text database. A Boolean search method was utilized with the primary key words: "pediatric traumatic brain injury", "age at time of TBI", "TBI severity", "behavior problems", "social problems", and "long term problems following TBI". The publish date was limited from 2009 to present. This narrowed the search to only the most recent studies but was not so restrictive that it would not produce an adequate number of results. My search was further narrowed by including only full text, peer reviewed research articles with abstracts, written in the English language. These search results were then sorted by "relevance" per the CINAHL database so that

articles whose content best matched the keywords were placed at the top of the search results. An abstract review was completed on a number of the most relevant articles in order to determine if they truly met the desired criteria for this systematic literature review. I chose to exclude articles that focused primarily on neuroimaging of the pediatric brain before/after a traumatic brain injury, and to exclude articles focused solely on the impact of parent behaviors on the post-TBI pediatric patient. While these items are pertinent in their own ways to pediatric TBI patients, I wanted to concentrate on purely the patient's behavior due to the brain injury itself, and what things should be considered in order to best accommodate these behaviors. Articles with strong abstracts then underwent a full text review, where the study was read in its entirety and all charts/tables were thoroughly examined to select the highest quality studies. The 10 articles that were selected during this final phase of evaluation were ones that examined the major themes that are the focus of this systematic review.





Results

Results of the studies included in this review of the literature revealed common themes found by researchers and their statements made regarding pediatric traumatic brain injuries. These themes include impact of age at time of injury, importance of proper identification of behaviors related to traumatic brain injuries and appropriate interventions, relationship between severity of injury and post injury behaviors, patient challenges with internalizing and externalizing problems, and the role of the home environment on post injury behaviors and the recovery process. Looking at the overarching themes of the research in this way allows clinicians to have a holistic view of the factors that come into play with a pediatric traumatic brain injury, bringing forward some of the main concerns from a healthcare provider perspective, the patients perspective, and the family perspective.

Impact of Age at Time of Injury on Post-Injury Behavior

The younger a child is at the time of a traumatic brain injury, the more symptomatic behavior they exhibited post-injury (Karver, et al., 2012; Ryan, et al., 2015; Wells, Minnes, & Phillips, 2009). When looking at a traumatic injury to an organ of the human body that is continuously changing for the first 25 years of life, the age of the patient plays an important role in treatment, as the injury "disrupts both current abilities and ongoing development" (Wells, Minnes, & Phillips, 2009), which will differ between patients based on age. In traumatic brain injuries in the pediatric population in general, researchers stated that "early childhood is theorized to be a time of increased vulnerability to the long-term effects of neurological insult. Specifically, injuries occurring during early childhood have been purported to compromise subsequent development to a greater extent than later insults" (Karver, et al., 2012). This systematic review examined specifically the relationship between age at injury and post injury behavior of these types of patients, and it was a common finding among the research articles reviewed that the younger the patient at the time of injury, the more symptomatic behavior they experienced post-injury. In particular, the patients who were younger at time of injury were noted to have "significantly higher levels of parent reported symptoms of ADHD and anxiety than children who were older at injury" (Karver, et al., 2012). Knowing how the age at time of injury impacts post-injury behavior is critical so that healthcare providers caring for these patients can have a better working knowledge of their patients' condition and subsequent deficits, but also so that the most appropriate interventions can be implemented, both immediately after the injury and on a long-term basis.

Importance of Proper Identification of TBI Related Behaviors, Appropriate Interventions

Proper identification of behavioral problems related to a child's traumatic brain injury, along with adequate initiation of interventions to aid with these symptoms, is critical for these patients' recovery process (Gagner, Landry-Roy, Bernier, Gravel, & Beauchamp, 2017; Konigs, et al., 2016; Ryan, et al., 2015; Wells, Minnes, & Phillips, 2009). In this unique patient population, it is critical for healthcare providers to be able to properly identify child behaviors related to their traumatic brain injury, implement necessary support and interventions, and educate the other care providers in this child's life about the child's atypical behaviors. It was found that commonly seen deficiencies for these patients include impaired generalization of learning, impaired decision making, internalizing behavior problems, and externalizing behavior problems. These issues could display themselves in the form of unsatisfactory academic performance, poor social functioning, or delinquency, just to name a few (Konigs, et al., 2016). Due to their presentation, it is not uncommon for these behavioral symptoms to be dismissed by parents, teachers, or other care takers of the child as simply being "bad behavior". But, with dissemination of knowledge and proper education, these symptoms can be recognized as being residual effects of the child's traumatic brain injury, and that child can get the support they need. "Early assessment…may have the potential to identify children who could benefit from rehabilitation interventions to prevent the emergence of externalizing behavior problems after TBI" (Konigs, et al., 2016). It has also been found that "younger children with TBI may benefit from cognitive–communicative remediation programs designed to improve interpersonal effectiveness, and thus reduce risk for maladaptive behavioral trajectories" (Ryan, et al., 2015). Based on the information

gathered, it is clear that proper identification of symptoms by healthcare providers, parents, and teachers is incredibly important. This then allows for the early implementation of intervention programs to assist patients with these symptoms and improve their future behavior, ultimately promoting for a significantly better long-term outcome than if no interventions were received.

Relationship Between Severity of Injury And Post-Injury Behaviors

The more severe the traumatic brain injury and the more damage sustained to the brain, the more post-injury behavior problems the child would exhibit (Chapman, Wade, Walz, Taylor, & Stancin, 2010; Karver, et al., 2012; Konigs, et al., 2016; Schwartz, et al., 2003). As with any other injury (to the brain or otherwise), it makes sense that more severe injuries will cause greater damage and therefore result in more drastic residual effects post-injury. When determining the complete cognitive capacity of patient's post-injury, it was found that "more severe TBI was associated with lower FSIQ", also known as full scale intelligence quotient (Konigs, et al., 2016). This measurement not only indicates the child's current cognitive capabilities, but also predicts their maximum functional capacity as an adult as well, which highlights the lasting effects of this type of traumatic injury.

Looking more specifically at behavior, researchers found that "children with severe TBI had significantly higher levels of internalizing and externalizing behavior problems as well as higher levels of executive dysfunction" (Karver, et al., 2012). This indicates that not only will these patients struggle with higher levels of anxiety, ADHD symptoms, rule-breaking, and aggression, but they will also have impaired social and

academic functioning compared to their peers. These issues stem from “involvement of fronto-striatal networks in both feedback learning and the emergence of disturbing behavior after pediatric TBI” (Konigs, et al., 2016). Another intriguing finding regarding severity of injury and post-injury behavior is that “children with moderate/severe TBI have impaired decision making based on feedback in terms of gains and losses in money or points” (Konigs, et al., 2016). This deficit will not only impact the patient as a child but can also significantly impact the individual’s ability to function independently as an adult if these deficits persist. Based on the common results among researchers, it is evident that severity of injury has a notable negative impact on the patients behavioral functioning after injury, and should be accounted for when implementing interventions during the recovery process.

Patient Challenges With Internalizing And Externalizing Problems

Pediatric patients who sustain traumatic brain injuries have been found to display significantly higher rates of both internalizing problems and externalizing problems after injury compared to their uninjured peers (Gagner, Landry-Roy, Bernier, Gravel, & Beauchamp, 2017; Karver, et al., 2012). Internalizing behavior problems include things such as depression and anxiety, while externalizing problems include things such as aggression, conduct disorders, and attention disorders (Gagner, Landry-Roy, Bernier, Gravel, & Beauchamp, 2017). Researchers found that the presence of these behavior problems after childhood TBI has “been linked to elevated rates of clinical syndromes, including ADHD, oppositional defiant disorder, and anxiety disorders” (Karver, et al., 2012). Regardless of the presence of previous behavior problems or psychosocial issues,

behavior observed post-injury has been found to be “brain-injury-specific and suggests that … early brain injury may cause disruption to the developing brain serious enough to result in behavioral changes” (Gagner, Landry-Roy, Bernier, Gravel, & Beauchamp, 2017). These behavioral findings related to pediatric traumatic brain injuries are important to recognize and need to be given adequate attention from healthcare providers, as “behavioral difficulties in the preschool years predict mental-health problems in later childhood, adolescence, and adulthood” (Gagner, Landry-Roy, Bernier, Gravel, & Beauchamp, 2017). Based on prevalence of these internalizing and externalizing behavior problems following pediatric traumatic brain injury, both short term and long term, it is clear that this patient population faces a unique set of challenges post-injury that require special attention from all care providers.

Role of Home Environment on Post-Injury Behaviors And Recovery Process

Households that have poorer levels of family functioning create an environment that is not conducive to proper recovery, resulting in higher rates of behavior problems and more severe behavior problems post-injury compared to pediatric TBI patients who had a more optimal recovery environment (Chapman, Wade, Walz, Taylor, & Stancin, 2010; Gagner, Landry-Roy, Bernier, Gravel, & Beauchamp, 2017; Schwartz, et al., 2003; Treble-Barna, et al., 2016; Wells, Minnes, & Phillips, 2009). When thought about simply, it makes sense that if an injury is not given the chance to properly recover due to dealing with additional stressors, it will not sufficiently recover. In terms of factors that positively impact recovery, it was found that “if a child is being reared in a nurturing, supportive environment and is accepted by members of the community they are more likely to be

receiving the support necessary to participate in age-appropriate social activities as well as assistance with improving cognitive functioning that may have been impaired through the brain injury" (Wells, Minnes, & Phillips, 2009). On the contrary, researchers also found that "psychosocial adversity, poorer family functioning, and maladaptive parenting styles were significant predictors of behavior and EF difficulties over a prolonged period of time following TBI", noting in particular the negative effects of lack of structure and lack of consistency in parenting techniques. (Chapman, Wade, Walz, Taylor, & Stancin, 2010).

Another aspect of a patient's home environment that was found to have a negative impact on the TBI recovery process was the presence of maternal distress, as "the relation between children's externalizing problems post-injury and maternal distress is reciprocal" (Gagner, Landry-Roy, Bernier, Gravel, & Beauchamp, 2017). In essence, the overprotectiveness that a mother may exhibit towards her child post-injury as a result of her own distress may further exacerbate the child's already present behavioral issues related to their TBI, such as aggressiveness or rebellion. Clearly, there are distinguishable differences in how a child can recover in different home environments. These factors should be taken into consideration by the patient's healthcare provider, and should be improved by the child's parents/guardians if possible, in order to optimize the child's recovery process.

Discussion

The common themes found among articles included in this systematic review articulate the various factors that influence pediatric traumatic brain injuries.

Understanding this type of injury and its recovery process helps to highlight the many challenges faced when providing effective care for a child (either as the parent, healthcare provider, or other caretaker) who has suffered a traumatic brain injury. When considering the age at time of injury, one must consider how vastly different an injury of this nature is for a child than it is for an adult because the child's brain is still growing and developing. Injury during this stage in life results in various behavior problems, which unfortunately are sometimes overlooked or incorrectly identified by caregivers in the patient's life. Aside from the challenges directly related to the injury sustained, one must also consider challenges introduced by external factors, such as when the child does not have an ideal home environment that will support an optimal recovery. Depending on the unique situation, the home environment of a child who has suffered a pediatric traumatic brain injury could so seriously stunt the recovery of the injury that it results in a higher incidence of permanent deficits. Taking these findings from the systematic review and using them to identify day to day challenges of this patient population helps healthcare providers to identify where interventions are needed in order to best support these children and ultimately aid in their recovery process.

Limitations

As with any research, there were a few commonly noted limitations among the studies included in this systematic review. A notable limitation with prominent impact on this literature review was the fact that only one database was used (CINAHL) to search for and collect research articles. This limited the number of studies that were examined by the author of this systematic review, and therefore put a limit on the type and quality of studies that were available to be selected from. If multiple databases from different

disciplines in the healthcare field were used to search for studies and research articles, there would have been a wider range of data to be explored by the author of this review, and the potential for different information to be included.

A primary limitation highlighted by researchers was the reliance on parents/guardians of the pediatric patients to provide accurate pre-injury and post-injury behavior ratings on their children. Collecting data in this manner and from these individuals introduces the risk of reports being altered or influenced by things such as bias, fatigue, anxiety, and parental concerns. Despite direction from researchers on how to most appropriately answer survey questions, there is still a strong possibility that some data collected is inaccurate due to these factors.

Another limitation that was noted in multiple studies was small sample size. Many researchers were concerned that the sample sizes studied, either as a whole or for a particular subgroup, were not large enough to have statistical power. One study in particular recognized that all of the participants in their study came from the same geographical area and the same treatment facility, therefore not providing a diverse group of patients, which could have an impact on the results of the study.

On this same note, a third limitation noted by multiple researchers was the high attrition rate among participants. Due to the need to not only collect baseline pre-injury data and data at the time of injury, but also collect data at multiple different intervals after the time of injury, it was found that most studies included in this systematic review had fewer and fewer participants returning to provide data as the length of time after injury

increased. Although this is out of the control of researchers, there is a significant chance that this issue of attrition impacted the results of these studies.

Conclusion

After completing a review of the most current literature, it has been found that the age at time of injury, severity of injury, and role of home environment play significant roles in a pediatric patient's behavior, both short term and long term, after suffering a traumatic brain injury. A younger age at time of injury, a more severe injury, and a home environment with poor family functioning and high levels of parental distress have all been found to be related to increased behavior problems, particularly surrounding ADHD, anxiety, and aggression in pediatric patients who have suffered traumatic brain injuries. It has also been found that identification of internalizing and externalizing behavior problems faced by patients, along with other traumatic brain injury related behaviors, are crucial to initiating proper interventions for these patients and providing them with the high level of care they need. By disseminating this information to healthcare professionals who work with this patient population, higher quality and more effective patient care can be provided to these children. Having a better working knowledge of the themes previously highlighted and how they play a role in a pediatric patient's traumatic brain injury allows healthcare professionals to be more deliberate with the type of interventions put into place, along with the timing of these interventions post-injury. This, combined with proper education to the parents and caregivers of these children will provide the most optimal environment that will allow for proper support of the TBI recovery process.

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